Population Parameters & Variable Recruitment in Virginia Tidal River Blue Catfish Populations

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Sampling Stations in Four Tidal River Systems
2001 - 2008

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Four Tidal River Systems
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Sampling Strategy 2001 - 2008

• Summer Low Frequency (15 pps) Boat Electrofishing
  – Fixed station design
    • Not all rivers sampled each year, and not all stations sampled in each survey
  – Single run per station
    • standardized to 600 s per run after 2002
  – EF boat and Pick-up boat
    • Two netters on each boat
    • Extra netters to assist in landing of unusually large fish (/> 20 Kg)

• Otoliths Collected for Age & Growth beginning in 2002
  – 2002 – 2004 otolith subsampling based on N per cm-group
    • High variability in individual growth => age-length key of limited value
  – After 2004, random subsampling
  – Age and Growth analyses based on over 5,000 aged individuals
Capture Efficiency Low and Variable
Unbelievably Abundant
One of two tanks collected during 10 minutes of electrofishing on the Rappahannock River
Dramatic Differences Among Rivers
Sample From Tributary of James
Increasing Catch Rates in James and Rappahannock

$\text{CPUE (fish/hour)}$

Survey Year

$r^2 = 0.99$

$r^2 = 0.98$

James
Pamunkey
Mattaponi
Rappahannock
Increase in Upper Limit of Age Structure

James River System

- **2002**
  - $N_{aged} = 330$
  - Age$_{max} = 13$

- **2004**
  - $N_{aged} = 216$
  - Age$_{max} = 15$

- **2006**
  - $N_{aged} = 533$
  - Age$_{max} = 19$

- **2008**
  - $N_{aged} = 468$
  - Age$_{max} = 20$
Increase in Upper Limits of Age Structure

York System

Age Distribution not as developed as James or Rappahannock

Mattaponi
• 1991 YC defines upper limit

Pamunkey
• 1991 or 1992 YC define upper limit

Mattaponi
- 2002: $N_{ aged } = 173$, $Age_{ max } = 11$
- 2004: $N_{ aged } = 131$, $Age_{ max } = 13$
- 2006: $N_{ aged } = 303$, $Age_{ max } = 15$
- 2008: $N_{ aged } = 266$, $Age_{ max } = 17$

Pamunkey
- 2002: $N_{ aged } = 148$, $Age_{ max } = 10$
- 2004: $N_{ aged } = 192$, $Age_{ max } = 12$
- 2006: $N_{ aged } = 327$, $Age_{ max } = 13$
- 2008: $N_{ aged } = 287$, $Age_{ max } = 15$
Growth Rates – Differences Among Rivers
2002

(mean total length-at-age w/ 95% Confidence Intervals)
Growth – Declines in Three of Four Rivers
(mean total length-at-age and 95% Confidence Intervals)
Declines in Growth Associated With Increases in Density in Pamunkey and Rappahannock

Mean Total Length Age-10 (mm) vs. Log$_{10}$ (CPUE +1)

- Pamunkey
- Rappahannock

$r^2 = 0.77$

$r^2 = 0.99$
Mattaponi – A Low Productivity System
Times are Tough
Redefining Gape Limitation
Growth Rates – Differences Among Rivers
2008
(mean total length-at-age w/ 95% Confidence Intervals)
Growth Rate – James
2009
(Mean Weight-at-Age w/ 95% Confidence Intervals)
Growth Patterns and Mortality => Rare Trophy Fish

2006 – Estimate of Total Annual Mortality Age 8 - 14 = 59%
Size Distribution – James River Blue Catfish

N = 5111
Temporal Shifts In Size Distributions

James 2002

TL(max) = 113
TL(mean) = 28.9
TL(median) = 26
N = 3,809

James 2008

TL(max) = 121
TL(mean) = 32.1
TL(median) = 28
N = 10,214
Significant Differences Among Rivers in Abundance and Distribution of Quality Size Fish

James

Mattaponi and Pamunkey

Rappahannock

CPUE (510) = 490 fish/hour
Mean CPUE / cm-group = 6.7 fish/hour
Median CPUE / cm-group = 4.2 fish/hour
N = 1,021

CPUE (510) = 86 fish/hour
Mean CPUE / cm-group = 1.2 fish/hour
Median CPUE / cm-group = 0.4 fish/hour
N = 201

CPUE (510) = 229 fish/hour
Mean CPUE / cm-group = 3.3 fish/hour
Median CPUE / cm-group = 0.5 fish/hour
N = 458

CPUE (510) = 18 fish/hour
Mean CPUE / cm-group = 0.3 fish/hour
Median CPUE / cm-group = 0.0 fish/hour
N = 18
Variable Recruitment

Graphs showing the relationship between Ln Number and Age for different locations:

- **James 2006**: $Z = -0.319$, $r^2 = 0.77$, $p < 0.01$
- **Mattaponi 2006**: $Z = -0.171$, $r^2 = 0.39$, $p < 0.05$
- **Pamunkey 2006**: $Z = -0.181$, $r^2 = 0.51$, $p < 0.01$
- **Rappahannock 2007**: $Z = -0.243$, $r^2 = 0.70$, $p < 0.01$
Residual

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r = 0.94
p < 0.01

r = 0.80
p < 0.01
Mature Female ~ 17 inches (Age 3 – 5 years)

40,000 – 50,000 fry per female
Conclusions

• Approximately 35 yrs post-stocking in the James and Rappahannock, and 25 yrs post-stocking in the Mattaponi... equilibrium had not been reached for blue catfish populations in Virginia tidal rivers

• With:
  – Trends of increasing density in the James and Rappahannock
  – Declining growth in the Pamunkey, Mattaponi and Rappahannock
  – Expanding age structure in the James, Pamunkey, and Mattaponi
  – And, increasing size structure in all four populations
Conclusions

• Density of blue catfish in these rivers is extremely high
  -- Electrofishing CPUE ranging from 223 to 6,106 fish/hr

• With trends of increasing density in the James and Rappahannock
  -- CPUE in the James and Rappahannock had reached 4,449 fish/hr and 6,106 fish/hr respectively by 2008.
Conclusions

- Differences in density, size structure, age structure, and growth among rivers were likely due, in large part, to time since population establishment and differences in watershed area and productivity.
Conclusions

• Variable Recruitment

  – In all four rivers, the 1996 year-class was strong and the 1999 year-class was weak, with a weak 2002 year-class occurring in three of the four rivers – an indication landscape-level environmental processes are involved at some level in determining recruitment in these populations.
Conclusions

• The ecological processes at work in Virginia tidal rivers are generally poorly documented, and information regarding trophic interactions and food web dynamics is lacking.
  – The impact this abundant introduced predator eventually will have on these systems is unknown and may be hard to define, given this lack of information.
  – Further work to address these information gaps is needed.
Conclusions

• The dramatic increase in population density in the James is of concern, with implications for the trophy fishery it supports.
  – Although no change in growth has been detected to-date in the James, declines in growth associated with increases in density have occurred in the Pamunkey and Rappahannock.

• Until the James population stabilizes (i.e. reaches an equilibrium state) concerns will remain regarding the trophy component of this important recreational fishery.
Growth in James River

- 8 yrs = 3 ½ lbs
- 10 yrs = 10 lbs
- 11 yrs = 20 lbs
- 12 - 13 yrs = 30 lbs
Growth in Rappahannock River

12 yrs = 10 lbs
14 yrs = 20 lbs
Is this to be the fate of the James River population?
Vast Increases in Harvest Could be Beneficial If Markets Would Support And Human Health Issues Addressed
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The 32 Inch Regulation

• Background
  – Anglers request protection for larger fish
  – Biological information indicates a “trophy” regulation is warranted
    • High mortality
    • Potential to “Recycle” fish
  – Virginia Department of Health (VDH) advisory
    • No consumption of blue catfish over 32 inches
  – DGIF contacts VMRC and others regarding impacts on the commercial fishery
  – DGIF staff proposes regulation to Board
    • Biological data
    • VDH advisory

• 2005
  – Public comment period
  – October, staff recommendation to Board
  – December, Board passes

• July 1, 2006 regulation goes into effect
Blue Catfish Size Distribution

Trophy regulation protects less than 1% of the resource

- Trophy fishery – multimillion dollar input to regional economy

N = 5111
Blue Catfish Size Distribution

Tidal James River – 2006

Red Box – Breeding population not affected by trophy regulation